

WHAT IS CLAIMED IS:

1. A dispensing device, comprising:
  - a plurality of discharge means for discharging a solution containing a biological sample;
  - discrimination means for discriminating the existence of a defective discharge of the solution in said discharge means; and
  - control means for selecting the discharge means in which the discharge status is not defective as a result of discriminating the defective discharge with said discrimination means, and performing discharge control of the solution containing the biological sample.
  
2. A dispensing device, comprising:
  - an electrode substrate having a plurality of separate electrodes formed in correspondence with each of a plurality of pressurized chambers to be filled with a solution containing a biological sample;
  - a pressurized chamber substrate, disposed so as to face said electrode substrate in a minute gap, having a discharge mechanism for adjusting the pressure inside said pressurized chamber by mechanical displacement of an elastically deforming diaphragm with an electrostatic force corresponding to a potential difference with said separate electrodes, and discharging said solution from a nozzle hole;
  - a drive pulse generation circuit for applying a drive voltage pulse of a prescribed waveform between said diaphragm and said separate electrodes in order to discharge said solution from said nozzle hole;
  - a drive current detection circuit for detecting a drive current flowing between said diaphragm and separate electrodes when said drive voltage pulse is applied;
  - discrimination means for discriminating the existence of a defective discharge of the solution based on the drive current detected with said drive current detection circuit; and

control means for selecting the discharge means in which the discharge status is not defective as a result of discriminating the defective discharge with said discrimination means, and performing discharge control of the solution containing the biological sample.

3. The dispensing device according to claim 2, wherein said discrimination means discriminates the existence of a defective discharge of the solution based on a current waveform of said detected drive current.
4. The dispensing device according to claim 2, wherein said discrimination means discriminates the existence of a defective discharge of the solution based on a peak current value of said detected drive current.
5. The dispensing device according to claim 2, wherein said discrimination means discriminates the existence of a defective discharge of the solution based on a differential waveform of said detected drive current.
6. The dispensing device according to claim 5, wherein said discrimination means performs said discrimination as a result of whether a peak waveform of said differential waveform appears on the positive side two consecutive times.
7. The dispensing device according to claim 5, wherein said discrimination means performs said discrimination as a result of whether a positive-side peak waveform appears on said differential waveform immediately prior to the falling edge of said detected drive current waveform.
8. A dispensing device as in claims 2, 3, 4, 5, 6, or 7, wherein said drive current detection circuit detects said drive current during the period in which said diaphragm elastically deforms toward said separate electrodes or during the period in which said diaphragm elastically deforms away from said separate electrodes.

9. A dispensing device as in claims 2, 3, 4, 5, 6, or 7, wherein said discrimination means performs said discrimination by comparing said detected drive current with a pre-stored drive current to be employed upon a normal drive.

10. The dispensing device according to claim 8, wherein said discrimination means performs said discrimination by comparing said detected drive current with a pre-stored drive current to be employed upon a normal drive.

11. A dispensing device as in claims 2, 3, 4, 5, 6, or 7, wherein said discrimination means performs said discrimination by comparing the synthesized current of said detected drive current obtained upon applying a drive voltage pulse between a plurality of sets of diaphragms and separate electrodes with a pre-stored synthesized current of a drive current to be employed upon normally driving a plurality of sets of diaphragms and separate electrodes.

12. The dispensing device according to claim 8, wherein said discrimination means performs said discrimination by comparing the synthesized current of said detected drive current obtained upon applying a drive voltage pulse between a plurality of sets of diaphragms and separate electrodes with a pre-stored synthesized current of a drive current to be employed upon normally driving a plurality of sets of diaphragms and separate electrodes.

13. A dispensing device, comprising:  
an electrode substrate having a plurality of separate electrodes formed in correspondence with each of a plurality of pressurized chambers to be filled with a solution containing a biological sample;

a pressurized chamber substrate, disposed so as to face said electrode substrate in a minute gap, having a discharge mechanism for adjusting the pressure inside said pressurized chamber by mechanical displacement of an elastically deforming diaphragm with an electrostatic force corresponding to a potential difference with said separate electrodes, and discharging said solution from a nozzle hole;

inspection pulse output means for applying an inspection pulse of a trapezoid waveform having a smooth rising edge gradient between said diaphragm and said separate electrodes;

a current detection circuit for detecting the excess current flowing between said diaphragm and separate electrodes when said inspection pulse is applied;

discrimination means for discriminating the existence of a defective discharge of the solution based on the drive current detected with said current detection circuit; and

control means for selecting the discharge means in which the discharge status is not defective as a result of discriminating the defective discharge with said discrimination means, and performing discharge control of the solution containing the biological sample.

14. A dispensing device, comprising:

a plurality of discharge means for discharging a solution containing a biological sample;

optical detection means for optically detecting whether said solution has been discharged from said discharge means;

discrimination means for discriminating the existence of a defective discharge of the solution from the detection results of said optical detection means; and

control means for selecting the discharge means in which the discharge status is not defective as a result of discriminating the defective discharge with said discrimination means, and performing discharge control of the solution containing the biological sample.

15. The dispensing device according to claim 14, wherein said discharge means is structured by including an electrode substrate having a plurality of separate electrodes formed in correspondence with each of a plurality of pressurized chambers to be filled with a solution containing a biological sample; and

a pressurized chamber substrate disposed so as to face said electrode substrate in a minute gap for adjusting the pressure inside said pressurized chamber by mechanical displacement of an elastically deforming diaphragm with an electrostatic force corresponding to a potential difference with said separate electrodes, and discharging said solution from a nozzle hole.

16. A dispensing device according to claims 14 or 15, wherein said optical detection means is structured from a laser light source and a light reception sensor, and detects whether said solution has been discharged from the change in received light intensity of a laser beam transmitted through said solution discharged as a droplet from said nozzle hole.

17. A dispensing device according to claims 14 or 15, wherein said optical detection means is structured from a CCD sensor, and optically detects said solution discharged as a droplet from said nozzle hole.

18. A dispensing device as in claims 1, 2, 13, or 14, further comprising recovery means for recovering the discharge mechanism which resulted in a defective discharge to a normal state.

19. The dispensing device according to claim 18, wherein said recovery means is suction means of a solution containing a biological sample.

20. A dispensing device as in claims 1, 2, 13, or 14, wherein said biological sample is protein.

21. A dispensing device as in claims 1, 2, 13, or 14, wherein said biological sample is nucleic acid.

22. A method of detecting a defective discharge of a solution containing a biological sample in a discharge mechanism for adjusting the pressure inside said pressurized chamber by mechanical displacement of an elastically deforming diaphragm, which is disposed so as to face an electrode substrate in a minute gap having a plurality of separate electrodes formed in correspondence with each of the plurality of pressurized chambers to be filled with a solution containing a biological sample, with the electrostatic force corresponding to the potential difference with said separate electrodes, and discharging said solution from a nozzle hole, comprising the steps of:

applying a drive voltage pulse of a prescribed waveform between said diaphragm and said separate electrodes in order to discharge said solution from said nozzle hole;

detecting a drive current flowing between said diaphragm and separate electrodes when said drive voltage pulse is applied; and

discriminating the existence of a defective discharge of the solution based on the detected drive current.

23. A method of detecting a defective discharge of a solution containing a biological sample in a discharge mechanism for adjusting the pressure inside said pressurized chamber by mechanical displacement of an elastically deforming diaphragm, which is disposed so as to face an electrode substrate in a minute gap having a plurality of separate electrodes formed in correspondence with each of the plurality of pressurized chambers to be filled with a solution containing a biological sample, with the electrostatic force corresponding to the potential difference with said separate electrodes, and discharging said solution from a nozzle hole, comprising the steps of:

applying an inspection pulse of a trapezoid waveform having a smooth rising edge gradient between said diaphragm and said separate electrodes;

detecting an excess current flowing between said diaphragm and separate electrodes when said inspection pulse is applied; and

discriminating the existence of a defective discharge of the solution based on the detected drive current.

24. A method of detecting a defective discharge of a solution containing a biological sample in discharge means for discharging a solution containing a biological sample, comprising the steps of:

optically detecting whether said solution has been discharged upon activating said discharge means; and

discriminating the existence of a defective discharge of the solution from the detection results.

25. A dispensing method, comprising the steps of:

discriminating a defective discharge of a discharge mechanism with a method according to any one of claims 22, 23, or 24 as a preparatory step for spotting a solution containing a biological sample on a substrate; and

selecting a discharge mechanism in which the discharge status is not defective and spotting said solution on the substrate.

26. The dispensing method according to claim 25, wherein a microarray is prepared by spotting said solution containing a biological sample on an array.

27. The dispensing method according to claim 26, wherein a protein chip is prepared by employing a large variety of proteins as said biological sample.